

NTP Budget Review Meeting

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February 18, 1998



ttd transportation
technology
development program

U.S. Department of Energy
National Transportation Program



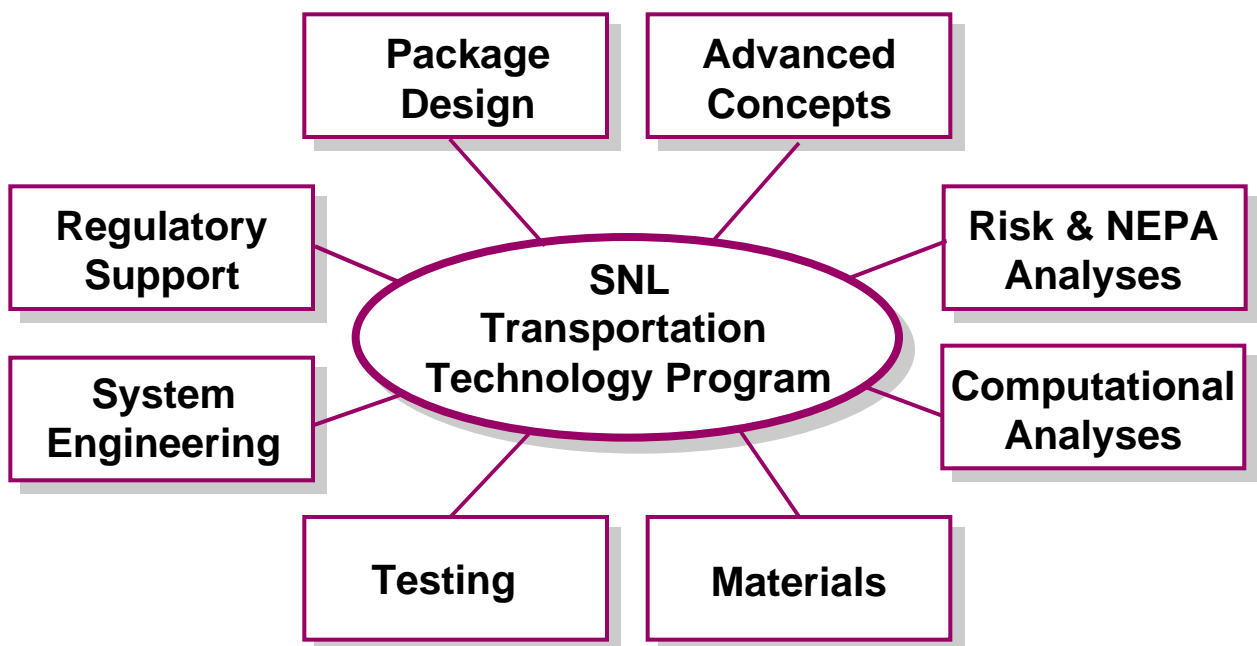
Transportation Technology Program

Advanced Transportation Technology Program is 100 Percent Applied to Meeting the Needs of DOE Programs.

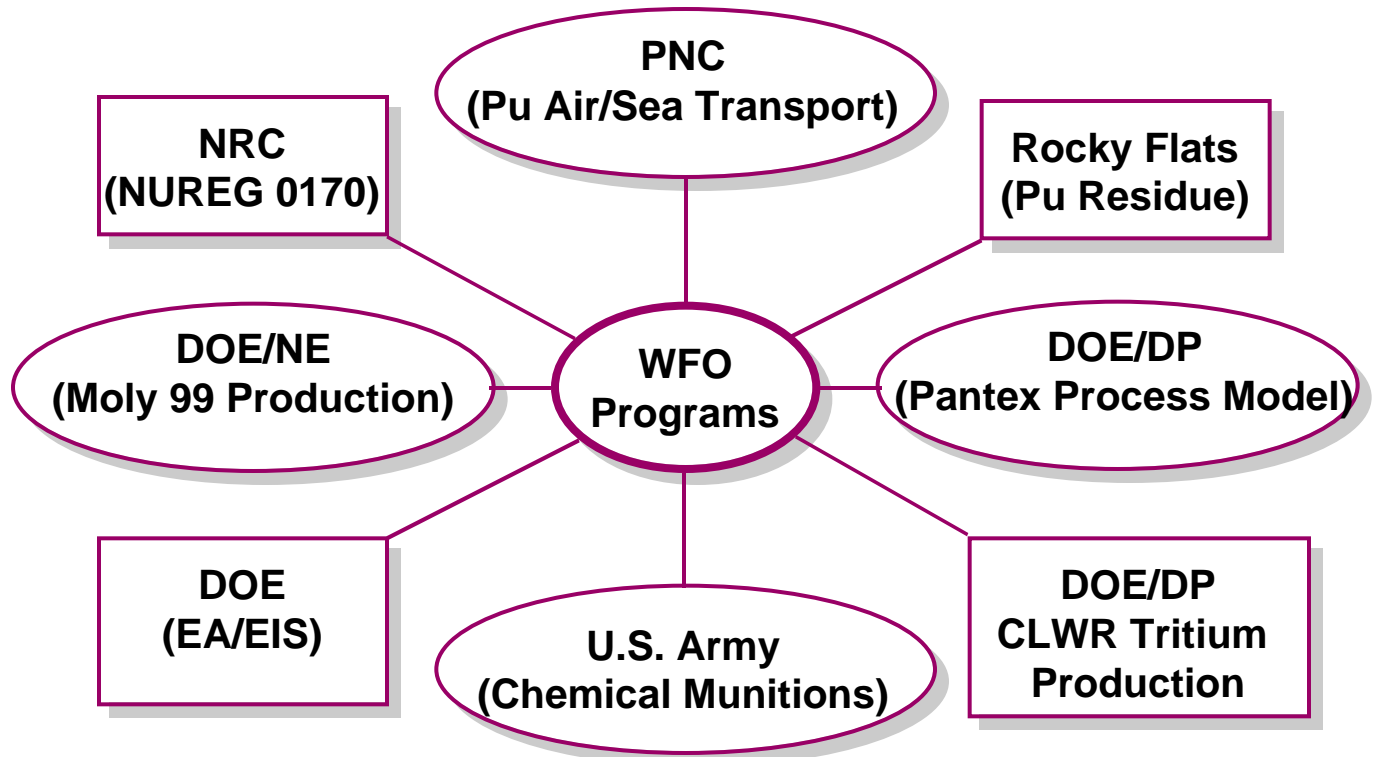
Basis for Work for NTP

- Provides basis for packaging safety analysis
- On Going Assessments
- EM Integration and Focus 2006 Planning
- System Analysis and Implementation Studies
- Long-term experience and knowledge of customer requirements, including ongoing regulatory and programmatic issues.
- Interactions with other DOE elements involved with logistics and operations activities
- Continued interaction and direct work for many DOE program elements
- Addressing regulatory excesses
- Assist programs in engineering transport systems including packages.
- Source of technical expertise for DOE transportation programs.

DOE's program of excellence in transportation technology has been in place at SNL since 1978, and today it is a world leader in transportation technology.



**Expertise is Applied Directly to DOE/EM
as well as other DOE and WFO Programs.**



Advanced Transportation Technology Program is Structured to Meet Current and Future DOE Needs

Technology Core Support Areas Are:

- **Risk Analysis**
- **Information Systems and Data Bases**
- **Systems Engineering and Implementation**
- **Decision Analysis**
- **Modeling and Simulation**
- **Structural, Thermal, Radiation, and Chemical Analyses**
- **Package Development**
- **Engineering Materials**
- **Scale Model and Full-Scale Testing**
- **Systems Concepts Development**
- **Technical Support to Enhance Success of All Other NTP Elements**

Advanced Transportation Technology Program Yields Significant Benefits to DOE Programs by:

- Providing the technical expertise to answer congressional inquiries.
Example: International Shipments By Sea
- Providing technical expertise
ExamplesRule making on double containment (before NRC at present);
soft package concepts (e.g., TRUPACT II); alternate materials; low-level waste
box analysis.
- Assuring technical validity of the concept that “The Package Provides the Safety.”
- Providing responsible technical justification on risk analysis for EA and EIS
and stake holder issues.
- Providing advanced computational, testing, and concepts for DOE use.
- Assuring technical capability to definitively answer issues of great importance to DOE.
ExamplesPu residues to WIPP, TRUPACT II Testing, IAEA technical
advisory, SeaRAM, Pu by Sea.
- Providing package development capability for state-of-the-art designs and concepts.
Examples: ONC, rebrazable seals, autoclave closures, wire mesh

Advanced Transportation Technology is Central to the Success of DOE Programs that Manage Nuclear Materials

- **Achieving economy of transport through optimized system design (Including packages)**
- **Achieving synergistic integration of transport systems into the larger systems being served**
- **Correcting regulatory excesses**
- **Providing credible assurances of safety, particularly for “highly-visibility” consensus standards bodies, nationally and internationally**

...and, this must be done by experts in the design, development, testing, and analysis of transport systems (including packages) acting in the interests of DOE programs.

Recent Applications of the Advanced Transportation Technology Program to DOE Program Success

- **Low Level Waste Box Analysis**
- Lead for DOE 6M packaging groups
- Double containment on Type B packagings - NRC rulemaking
- NRC white paper on alternate materials - ductile iron
- SNF sea transport (IAEA CRP) - SeaRAM
- 99Mo packaging issues
- Richland cesium capsule shipments - BUSS cask
- EM Integration and Focus 2006 planning
 - Identification and resolution of technical issues*
 - Gas Generation*
- New technical concepts in packaging
 - Rebrazable Seals*
 - Autoclave Closures*
 - Advanced Impact Limiter Materials*
 - Advanced Thermal Insulation Materials*
- Tritium Packaging - LWR generated
- Rail Transport Risk Assessment
- Spent Fuel Program Support
- Foreign Research Reactor Fuel Return Support

Advanced Transportation Technology Program Supports DOE Urgent Safety Studies

Low Level Waste Box Analysis:

Sandia was called upon by DOE/ALO to provide an analysis of a waste box that “leaked” during transport from Fernald to Nevada Test Site.

The analysis utilized incident data that was gathered, stress analyses, and metallurgical analyses in reporting the conclusion of the failure.

An “L” shaped section of the low level waste box that was analyzed is shown.



Conclusion

**The Advanced Transportation Technology Program
is 100 Percent Applied
and
is Essential To Meet
The Needs of DOE Programs.**

Risk of Rail Shipments

Problem: Modal Study Rail Accident Event Tree uses CA freeway data to develop scenario probabilities, does not account for benign derailments. So estimates of severe rail accidents probabilities and severities are suspect.

Approach: Modify Modal Study rail event tree, develop event probabilities from rail accident and rail line data, estimate credible release fractions for scenarios sufficiently severe to challenge a Type-B cask

Collaborative Program: Work being performed jointly with risk assessment staff of the DOT Volpe Center and the American Association of Railroads

FY 99 and FY00 Activities: Based upon the evaluation of rail accident data in FY98, prepare a plan to address the data deficiencies and process to address future data needs. Submit report.

1.2.1.1

Risk of Sea Shipments

- **Background:**
- **DOE will ship significant quantities of RAM by Sea**
- **13 year FRR spent fuel campaign is now underway**
- **Shipment of Plutonium material to Europe and of MOX fuel back to North America being considered**
- **Shipment of fissile materials from former USSR republics to US**
- **All schedules would be adversely impacted if restrictive revisions to IMO/IAEA regulations were to be adopted.**

Risk of Sea Shipments

The adequacy of the regulations (hypothetical impact accident environments) has been questioned.

- This task is aimed at determining what the accident condition loadings on a RAM package are during a severe ship-to-ship collision, the response of containers due to thermal loading, corrosion of packagings and source term development.
- This activity addresses several questions:
 - Does the colliding ship penetrate into the struck ship far enough to contact the RAM package? For break-bulk? For container ships?
 - If the RAM package is contacted, what are the magnitudes of the impact and crush loads it is subjected to?
 - What are the combustion characteristics of cargo carried in break-bulk and container ships and restricted air flow in cargo holds?
 - What source terms are available for release? For VHLW? For PuO_2 ?
 - How do contents corrode and how much is available for release?
 - What are the risks of transporting radioactive cargoes?

1.2.1.1

Sea Transport of RAM Risk Assessment Framework Developed

Scenario Probabilities from Event Trees, accident frequencies, and hand calculations

Crush Probabilities from shipping practice and Minorsky and finite element collision calculations

Chance of thermal releases from fire tests, CFS calculations, shipping practice, and a hold fire model

Source Terms by recalculating Release Fractions using MELCOR with a hold fire model

Consequences from MARINRAD, RADTRAN, and MACCS calculations for accidents at sea, in coastal waters, or in ports

1.2.1.1

Principal Results to Date

Collisions depend on traffic density, fires don't

Collisions unlikely to damage cask; forces will be relieved by collapse of ship structures, not cask structures

Fire start in RAM hold is unlikely; so is fire spread to RAM hold

Most RAM released to cask interior will deposit on interior cask surfaces; so cask retention fractions are large and cask-to-environment release fractions are small

Consequently, risks of maritime transport of RAM are very small

1.2.1.1

Proposed Maritime Accident Risk Studies

FY99:

Performance of a shipboard fire test where combustion air is restricted

Development of combustion characteristics of broad classes of cargoes carried on bulk-freighters and container ships

Performance of finite element collision calculations for a purpose-built ship

Determination of temperature dependence of rates of corrosion of stainless steel canisters by seawater

Development of test plan for experiments to determine forces required to push cask through a ship shell

Development of source terms for PuO_2 and VHLW ship collision accidents

1.2.1.1

Proposed Maritime Accident Risk Studies

FY00:

Estimation of airflow rates into break-bulk freighter cargo hold through open ventilation shafts and bulkhead doors

Use results of previous fire tests, surveys, and airflow into cargo holds to develop probabilities of fire spread from random fire start locations to a RAM hold; and probability that fire will be severe enough to cause a release

Development of model of containerized cargo

Performance of finite element collision calculations for a container ship

Determination of temperature dependence of leach rates from VHLW for several important radionuclides

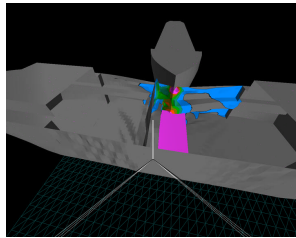
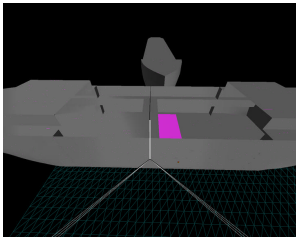
Measure forces required to push a cask through a hull

Develop generic maritime RAM transport risk estimates

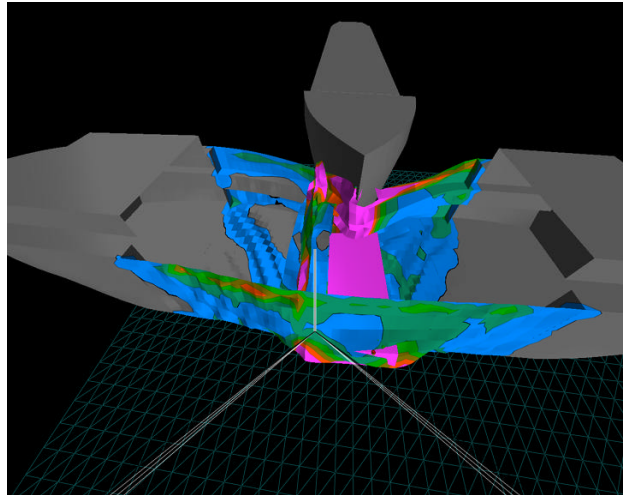
1.2.1.1

Penetration to the RAM package is not sufficient to damage the package.

- Crush force is relieved by flexibility of ship structure
- Rigid bow assumption leads to large forces on one side of package
- Crush can only occurs if there are opposing forces

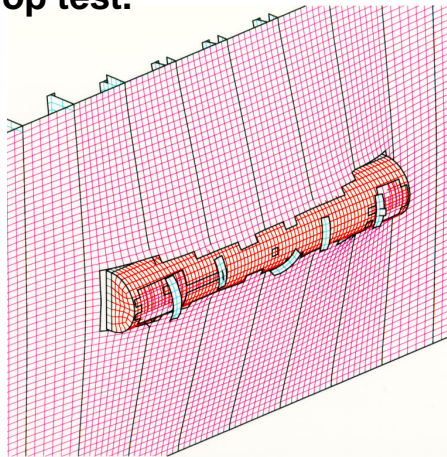


- 10 Cray hours
- Sandia developed codes
- Multiple contacts
- Only FE analysis that shows forces on RAM package
- Supports empirical method for deck penetration



The maximum crush force is limited by the strength and stiffness of the ship's hull structure.

Refined analyses of a package penetrating a ship's hull have been performed. These analyses indicate the maximum possible crush force is similar in magnitude to the inertial crush force during the regulatory 9-meter drop test.



These analyses were performed without other cargo. Additional analyses are currently being performed to determine the effect of intervening cargo on the maximum crush force generated in a collision.

Risk of Sea Shipments

FY99 and FY00 Activities

Ships

Charter Freighter

Special Topic to be Examined

- *Probability crush forces not relieved*
- *Fire spread when oxygen limited*

*Break-Bulk Freighter
Container Ship*

- *Probability crush forces not relieved*
- *Crush model for containers*
- *Fire spread model for containers*

Purpose-Built Shi

- *Penetration of double hull*
- *Probability crush forces not relieved*

Waste Forms

Spent Fuel

- *Particle production/entrainment*
- *Release by leaching*

PuO₂

- *Canister Failure by Corrosion*
- *Particle Entrainment*

VHLW

- *Canister failure by corrosion*
- *Confirm melting and fracturing to small particles will not take place*
- *Release by leaching*

DOE Support

- *EM-70, CP-1, IAEA/CRP, IMO, Convention, and Litigation*
- *Identify aspects to be finalized for SeaRAM*
- *Response to NCI paper on VHLW shipments, and DOS support*

1.2.1.1

Risk Assessment Support

Examples of Application/Requests Received

- **Taiwan Spent Fuel Movement EAs & Litigation (DOE/EM)**
- **Foreign Research Reactor Urgent Relief EA & litigation (DOE/EM)**
- **Address intervenor & stakeholder concerns**
- **Y-12 EA & Public Information Meetings (DOE/DP)**
- **Project Sapphire (now declassified)**
- **NRC - NUREG-0170 re-analysis**
- **Canadian request for Assistance (Ontario Hydro)**
- **Risks of transportation to the commercial facility at Hanford (Washington Department of Health)**
- **Examine alternative disposition methods for sodium bonded SNF (ANL East)**
- **DOE Office of General Counsel**

1.2.1.1

RADTRAN and Risk Analysis Activity

RADTRAN Code

- **National and International Standard; source code for IAEA's INTERTRAN code**
 - **Approx. 150 users (LANL, Bettis Labs, UNLV)**
 - **RADTRAN 5 - Current Version**
 - **Input-File-Generator software (downloadable from RADTRAN website)**
- **Uncertainty and Sensitivity Analyses**
- **Probabilistic Analysis with Latin Hypercube**
- **Sampling (LHS) "shell" Code developed at SNL**

Workshops

- **RADTRAN Workshop for Korean Nuclear Industries**
- **Waste Management Conference**
- **PATRAM**

1.2.1.1

RADTRAN/Risk Analysis Future Activities

FY99 Activities and Milestones

- *Continue to maintain RAM transportation literature data base.*
- *Issue maintenance release of RADTRAN5 with enhanced graphics capabilities*
- *Software QA of RADTRAN and RADD OG*
- *RADTRAN training materials on Home Page*
- *Sample RADTRAN results on Home Page (DOE ORISE Fellowship)*
- *Archive and conduct internal audit*
- *Hold RADTRAN User Community Conference and Workshop*
- *Maintain Risk Management services*

FY00 Activities and Milestones

- *Update graphical users' interface (GUI) to include LHS and GIS capabilities and make it available on the RADTRAN website.*
- *Expand the RADTRAN Software QA Plan to include the auxiliary codes and publish verification/validation report*
- *Hold RADTRAN User Community Conference and Workshop*
- *Maintain Risk Management services*
- *Breakdown RADTRAN costs to show maintenance, workshops, use of service*

1.2.1.1

DOT 6M Subgroup

The objective of the NTP DOT 6M Subgroup was to develop the technical basis, draft criteria, and a sample generic application related to the continued use of DOT 6M specification packagings for the shipment of greater than 20 curies of non-exempt forms of plutonium in support of DOE programs. This continued use supports the provisions of DOE Order 460.1A Section 4.c.1.

The DOT 6M Subgroup was organized by Ashok Kapoor of the DOE NTP with representation from a number of DOE Field Offices and DOE contractors.

The Subgroup held a DOE 6M User Group meeting on December 17-18, 1997 in Oak Ridge, TN.

Draft copies of the guidance documentation was presented to the DOE DOT 6M users.

Comments on the draft guidance documentation will be received, incorporated and transmitted to DOE Headquarters Certifying Official (HCO), Mike Wangler, EM-76, for final review and implementation.

1.2.1.1

Regulatory Support

Objective

- To support DOE in matters related to the development of international regulations for the safe transportation of radioactive materials and support development of standards.

Tasks

- Development of draft regulatory working papers to be submitted to the IAEA or national regulatory organizations (DOT, NRC)
- Participation in the development of national consensus standards for radioactive material packagings and ancillary equipment.
- Participation in technical committees, at DOE request, such as ASTM, ANSI, ASME, ASME-NUPACK and IAEA
- FY99 and FY00 Activities - Continue Regulatory Support services. Submit annual summary report.

1.2.1.2

Technical Data System Support

RMIR - Radioactive Material Transportation Accident Database

- Provides a measure of radioactive material transportation system safety.
- To respond to technical issues for DOE/HQ. Sandia can and has provided detailed technical analyses, technical support, and safety and systems assessment to address public concerns regarding the safety of radioactive material (RAM) transportation.
- SNL often represents DOE in matters concerning packaging technology, nuclear safety, and communication of risks associated with RAM transportation. Such representation provides contact for DOE with Federal agencies, the U.S. Congress, and public interest groups.

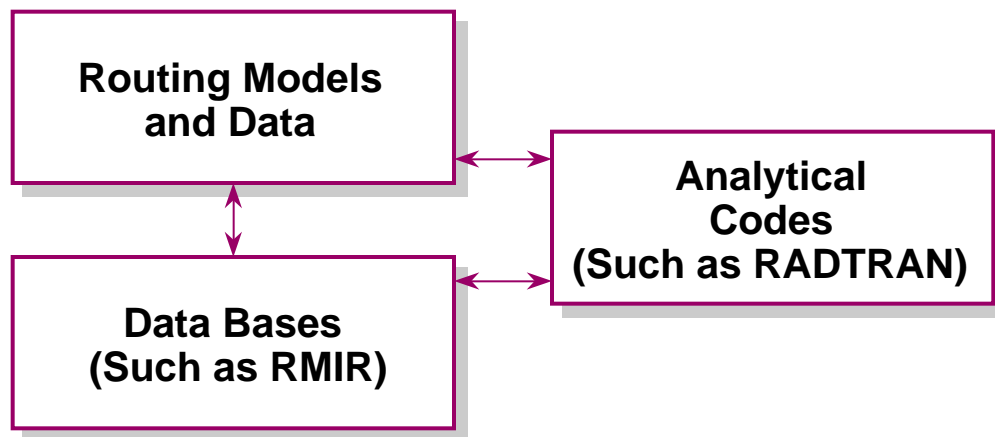
FY99 and FY00 Activities:

- Maintain accuracy and report to NTP Albuquerque (quarterly) database information and customer requests of support through quarterly reviews/updates.
- Maintain RMIR operations at high level of reliability (98% availability)
- Prepare and submit annual accident/incident and RMIR reliability information report to NTP Albuquerque
- Performance Measures: Annual Summary RMIR Report, Status RMIR database review/upgrade and customer utilization report

1.2.1.3

TRANSNET

A suite of computer codes, databases and analytical tools used to support all program areas of the DOE transportation mission covering the Safe, Secure and Economic Transport of DOE materials, including hazardous (particularly radioactive) materials.



1.2.3.1

TRANSNET ACTIVITIES/MILESTONES

FY99 Activities:

- ***Maintain operations at high level of reliability (98% availability)***
- ***Study potential to relocate RADTRAN and RMIR applications/databases to DOE NTP Web Home Page and server located at HQ EM-14. SNL and ORNL work together to assure quality of TRANSNET service at less cost***
- ***Provide annual Users Summary and Operations Status Report***
- ***Performance Measures:***
 - ***Provide NTP Albuquerque with Annual TRANSNET Users Summary and Operations Status Report***
 - ***Report from study to relocate RADTRAN and RMIR applications/databases to DOE NTP Web Home Page***

1.2.3.1

TRANSNET ACTIVITIES/MILESTONES

FY00 Activities:

- ***Maintain operations at high level of reliability (98% availability)***
- ***Implement (if study indicates) relocation RADTRAN and RMIR databases to DOE NTP Web Home Page and server located at HQ EM-14***
- ***Provide annual TRANSNET Users Summary and Operations Status Report***
- ***Performance Measures***
 - ***Provide NTP Albuquerque with annual TRANSNET Users Summary and Operations Status Report***

1.2.3.1

Data Process Methods

Description of Data Process Methods

Continue the development of capabilities for automated mapping, spatial population and demographic analysis, and mobilization route characterization. Develop improved atmospheric dispersion model allowing user input for TRANSNET.

FY99 and FY00 Activities

Continue development of an automated, GIS-based, population model for accident-risk calculation; this will include creation of software tools and verification of the model.

Apply the automated “incident-free” population model to statistical studies of population characteristics along typical routes employed for spent nuclear fuel, waste etc. shipments.

1.2.3.2

Packaging Management

Evaluate NTP to determine systems and components needs

- Identify deficiencies and critical needs in DOE's short and long term radioactive material transportation program
- Provide solutions for deficiencies to critical needs not filled by current DOE programs or private industry
- Support DOE with evaluations of specific programs or packages
- Qualify and optimize designs for new or modified packages (DOE and WFO)
- Understand and solve critical packaging problems
- Assure that all regulations have been satisfied and the package is ready for testing or certification
- Support goal-oriented applied research to solve common packaging problems

1.3.1.2

Packaging Fleet Management and Operational Safety Planning

COMPLEX WIDE PACKAGING FLEET MANAGEMENT

- Coordinate with Packaging Management Council - ascertain current packaging status
- Develop and maintain a global data base of DOE packagings or expand an existing systems (i.e., Packaging Management Tracking System, to capture the expanded data requirements
- Identify cases DOE shipping campaigns will be limited due to limited supply of containers
- Collate and summarize ongoing development programs
- Construct system to align packagings with materials planned for shipment - project needs
- Allocate packagings to the best advantage of DOE
- Determine new packaging need projections and lead time
- Determine projected container withdrawals and restrictions
- Expand envelope of packaging to provide greatest functionality for greatest range of materials for transport

1.3.1.2

Transportation Systems Modeling and Simulation

Effective management of logistics and operations requires:

- a system perspective
- accurate and timely data on material movement requirements
- quantity and type of waste streams for disposal
- available packages (containers) and their status, location, and conditions

Decision support tools, based on proven industry standards, must be an integral part of logistics and operations for effective decisions on:

- investment in shipping containers and other assets and allocation of available equipment
- routing and scheduling of individual shipments

1.3.1.2

Transportation Systems Modeling and Simulation (continued)

Logistics modeling activities for FY99-00

- ***Review current logistics modeling tools used by DOE/private industry. Identify user needs, data requirements, and data sources***
- ***Establish packaging baselines for major programs***
- ***Develop a prototype logistics model, focused on a particular end user, including complete data needs assessment, and impacts demonstrated***
- ***Complete development and implementation of a suite of optimization and simulation tools for an end user***
- ***Investigate the need for disruption risk analysis of the EM complex***

1.3.1.2

Fleet Operational Safety



ALARA Improvement of Packaging Maintenance and Operations

- Assessment of appropriate DOE safety programs
- Packaging operational safety reviews
- Enhanced occurrence report analysis and derivative actions for packaging/operations
- Establish method to verify required testing of less than Type B packaging
- Support Emergency Response and Preparedness Program
- Review Packaging Training (SARP, QA/C, Operational)
- Emphasize Packaging Quality Assurance and Control Programs
- Provide Packaging Technical and Safety Assistance
- Influence Stakeholder Knowledge/Perceptions of Packaging Safety

1.3.1.2

Packaging Management

FY99 and FY00 Activities

- ***Analyze technical basis for amendments to 10 CFR 71.63 and “no venting” rule***
- ***Resolution of orphan waste, decertified, and unusable packaging***
- ***Determine needed characterization of transported materials***
- ***Investigate inclusion of uncertainty in 10 CFR Part 71***
- ***Support emergency response teams***

1.3.1.2

Packaging Concepts

New and innovative packaging technologies continue to be investigated and developed

- **Wire mesh overpacks for Type B transport packages**
- **Perforated metal sheet-aramid cloth package for PU air transport**
- **Rebrazing technology for storage and transport packages**
- **Quick closures for large transportation packages**
- **Electronic identification for tracking and monitoring packages**
- **Vermiculite materials for impact and thermal protection**

Packaging Concepts

This program is essential for the DOE since a great deal of radioactive material needs to be transported in the future but the form, quantity and facility interfaces have yet to be determined.

To allow the DOE to respond in a timely manner to its transportation needs, it is imperative that design concepts and tools be developed in the near term.

FY99 and FY00 Activities: Continue to develop packaging system concepts for identified DOE transportation needs utilizing the new concepts that have been developed, and continue with the support and assistance of EM to identify and develop packaging system concepts for other DOE program offices. Provide annual report on Package Systems Concepts.

Chemical Interactions Program

Experimentally evaluate the interaction of simulant mixed wastes with **plastic transportation container materials** and to provide significant technical data to the NTP



Complexities of the DOE's mixed waste preclude the use of existing chemical compatibility data.

1.3.2.2

Chemical Interactions Program

FY99 and FY00 Activities:

Continue comprehensive testing of seal materials. Testing of the next elastomer, Viton rubber in aqueous simulant Hanford waste. Exposure of seal material to four gamma radiation doses followed by exposure to the aqueous simulant waste for four time periods at three temperatures. Submit testing reports and annual summary report.

Structural Analysis

The structural analysis task provides package designers with state-of-the-art tools for determining the response of packages to regulatory and extra-regulatory accident conditions.

The ability to determine the response of packages, and transportation vessels, to accident conditions provides for safer and more efficient designs.

State-of-the-art analysis tools, such as non-linear dynamic finite element codes (inelastic analysis), can accurately predict this response, but are not yet readily available or acceptable to package designers and certifying agencies.

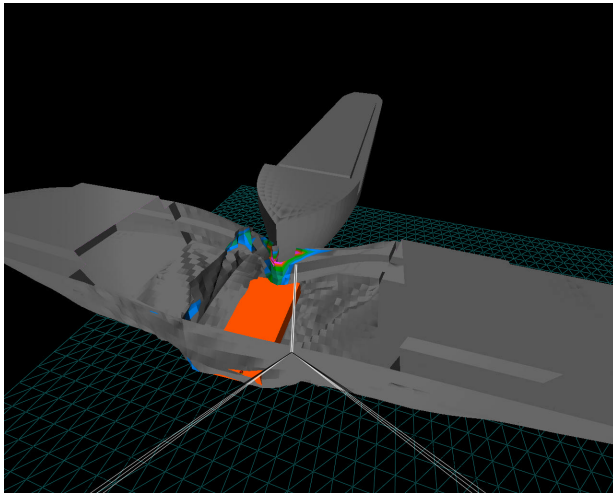
Inelastic analysis is the only analytical method available to determine the response of packages to the extra-regulatory accidents required when performing risk assessments.

The ability to determine this response without physical tests provides lower cost and faster response in these assessments.

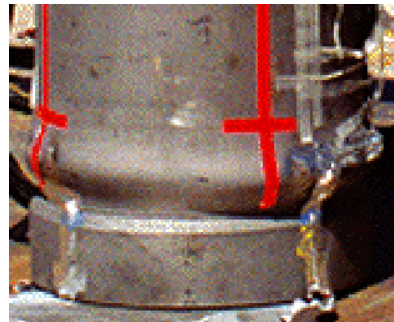
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Structural Analysis

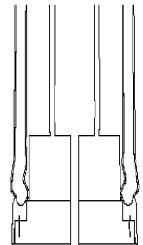
Model of Ship Collision with RAM Packages



Comparison between the test and analysis results in this program validated the ability of non-linear dynamic analysis techniques to accurately capture the response of packages to impacts resulting in large deformations.



**Test
results**



**Analysis
results**

1.3.2.2

Structural Analysis

FY99 and FY00 Activities:

Begin work on ASME Code Case for inelastic analysis for RAM transportation and storage packages. Compare analysis and test results for curved shell puncture tests. Continue training activities for advanced structural analysis techniques. Develop and conduct curved puncture tests.

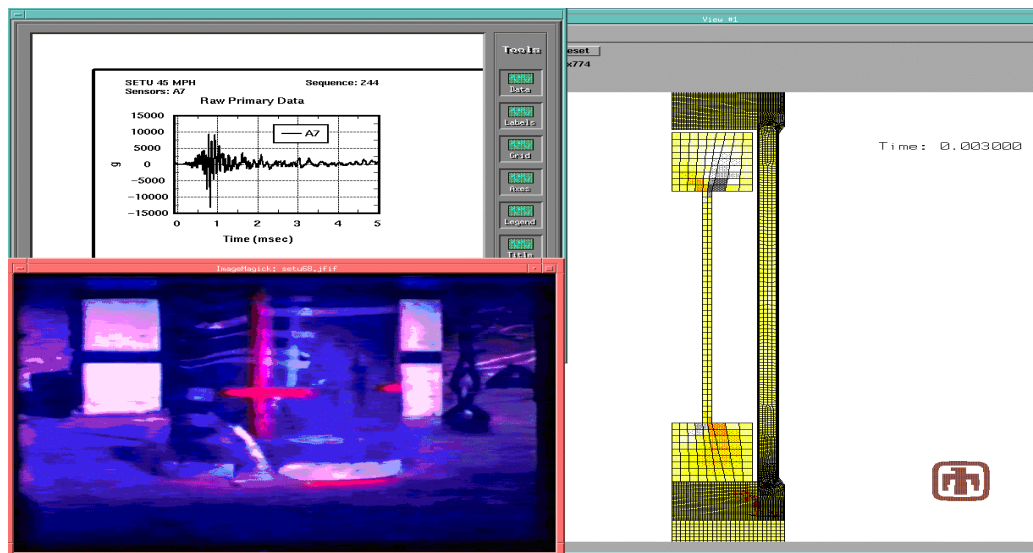
Complete activities related to benchmarking of puncture analyses. Support the development of the inelastic standard for puncture accidents in ASME. Support EM projects with structural analysis on an as-needed basis.

Advanced Visualization Techniques

The large amounts of data produced by analyses and tests requires advanced visualization techniques for communication with Stakeholders.

Sandia has developed and integrated a suite of visualization tools that allow the engineer to simultaneously view analytical models, test data, and high speed video coverage of an accident simulation.

FY99 and FY00 Activities include software integration and upgrading hardware to enable rapid data analysis.



1.3.2.2

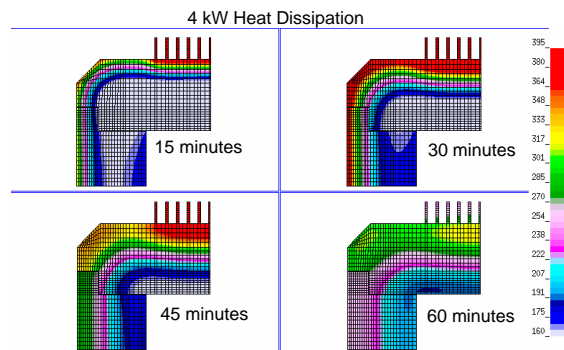
Thermal Analysis

- **Analysis in support of projects, testing and risk analysis**
- **Applied research aimed at better understanding of the package pool fire environment**
- **Selection and qualification of thermal materials for use in package applications**
- **Provide input on regulatory issues and stakeholder comments and papers**
- **Support thermal analysis communication through the Thermal Specialists' Meeting held biannually**
- **Add instrumentation to routine fire tests for increased value**
- **Provide nucleus for research such as Risk of Sea Shipments**

1.3.2.2

Thermal Analysis

Experimental Fire



BUSS cask analysis



Regulatory pool fire

1.3.2.2

Thermal Analysis

FY99 and FY00 Activities:

- ***Continuing project support including SARP analyses***
- ***Fire series with Coast Guard: heat transfer in cargo fires with limited oxygen***
- ***Select promising thermal materials for evaluation and qualification to include; phenolic foam and light weight inorganics such as Kaolite***
- ***Complete Thermally hardened data logger***
- ***Make workstation fire model available to package designers***
- ***Complete and calibrate workstation fire model***
- ***Hold 5th Thermal Specialist Meeting***
- ***Support design, risk analyses on “as needed” basis***

Components: Impact Limiters and Seals

Two Vital Components of a Transportation Container

- Failure of either can cause the package to not meet regulations or lead to a material release.
- This program gives programmatic savings by providing data on the physical parameters for both components for DOE and other package designers at little or not cost;
 - by measurement
 - gathering the data from other sources

Component Needs Include:

- Non combustible impact limiting materials
- Better confinement methods for high kinetic energy vents
- New methods of closing
- Quick closures for packages
- New Identification and data techniques
- New tamper protection devices

1.3.2.2

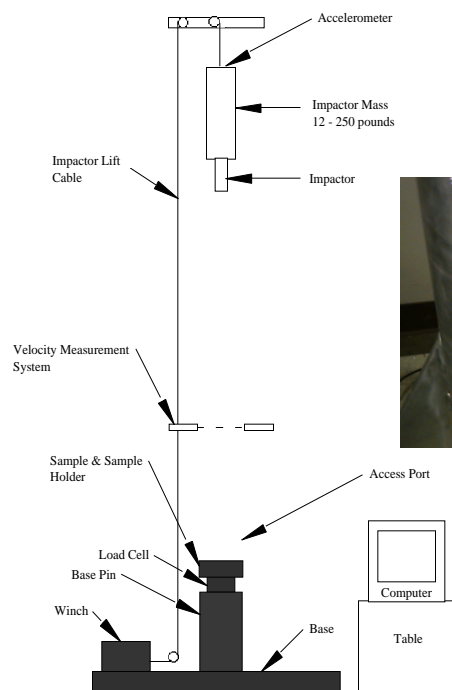
Components: Impact Limiters and Seals

FY99 and FY00 Activities

- ***Continue testing of impact limiter materials and enter data into WWW data base.***
- ***Conduct aging and radiation damage experiments on elastomeric seals.***
- ***Examine the effect of set on the leak rate of elastomeric seals.***
- ***Enter data in WWW data base.***
- ***Submit annual reports on Impact Limiter activities and Seal activities.***

Impact Limiters and Seals Components

A drop tower has been built to evaluate impact limiter materials



1.3.2.2

Metallic Corrosion

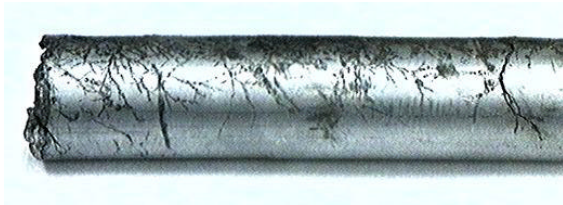
OBJECTIVE:

- **Define Criteria for candidate material selection**
- **Define a test matrix for material compatibility with waste simulant**
- **Evaluate material performance when subjected to a simulant waste**

GOAL:

To provide package design engineers with a choice of materials with which to manufacture transportation packages that exhibit enhanced performance upon exposure to hazardous, mixed and radioactive waste.

Metallic Corrosion



FY99 and FY00 Activities:

Continue testing matrix of updated simulated waste compositions on candidate materials. Respond to corrosion issues that are routinely brought to this subtask for resolution. Submit annual report.

Materials Characterization

Experimentally determine the thermophysical properties of materials such as metals, plastics, and ceramic insulators used in transportation packaging and address other materials issues



Thermoanalytical Instrumentation

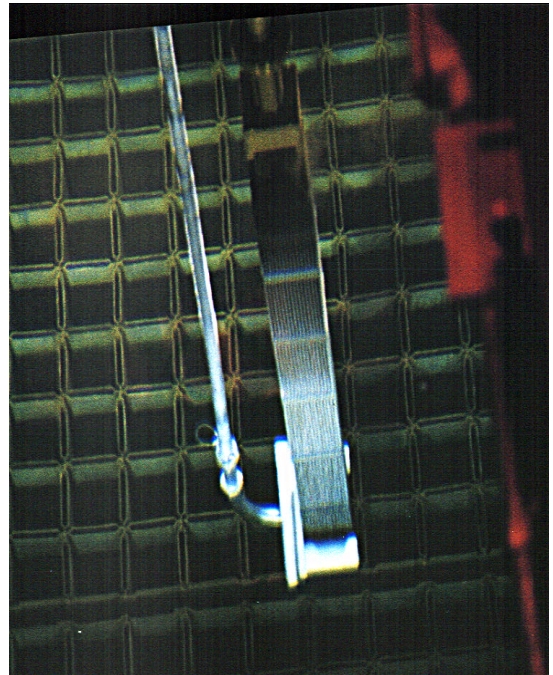
FY99 and FY00 Activities:

Follow up preliminary evaluation of the thermophysical properties of packaging materials by undertaking an experimental program to measure these properties for additional materials. Determine structural changes in materials for heterogeneous solids such as ceramics and polymeric foams. Provide reports to DOE.

1.3.2.2

Radiation Measurements

- Used for many years to aid in the characterization, handling, and processing of spent nuclear fuel (SNF)
- Essential to ensuring the criticality and shielding safety of RAM transportation packagings
- Non-destructive assay (NDA) radiation measurement techniques have been determined to be critical to the DOE SNF program



Radiation Measurements

Use of radiation measurements to ensure the safety of transportation packagings will not only have applications within DOE, which has the responsibility for managing DOE spent nuclear fuel, but will also have applications to other DOE programs.

**Commercial Spent Nuclear Fuel
Excess Weapons Material
Safeguards and Security**

FY99 and FY00 Activities:

Conduct follow-up identification of radiation measurements needs for transportation packagings to determine if the needs have changed or if they have been met. Asses the impact of development of policies to ensure that technologies are available. Submit annually report.

1.3.2.2

The ability to test packages and components is a vital competency for DOE.

- The most convincing method of determining if a package meets the requirements of 10CFR71 is by testing.
- Testing is used to benchmark analyses and analysis tools that can be used to support package certification.
- Data required for analytical models is determined by testing.
- Testing is used to determine response of components where no analytical models are available.
- Testing supports package concept development.
- Sandia is uniquely qualified to perform the entire range of transportation testing for full-scale and sub-scale prototype packages.

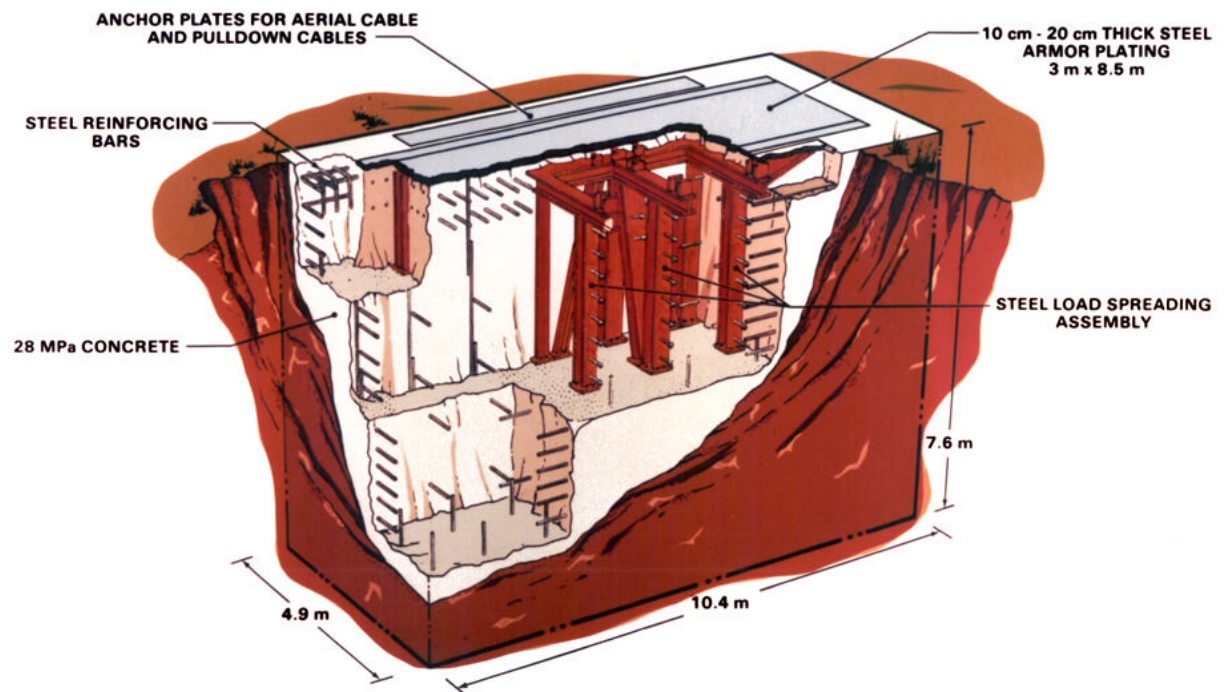
FY99-FY00 Activities: Maintain MIDAS Hardware and Software. Submit Annual Report

Impact and puncture testing is conducted at the aerial cable facility



1.3.3.1

Unyielding Target at the Aerial Cable Facility



910 TONNE ARMORED TARGET AT SANDIA NATIONAL LABORATORIES

1.3.3.1

High Velocity Impacts can be Conducted at the Rocket Sled Track



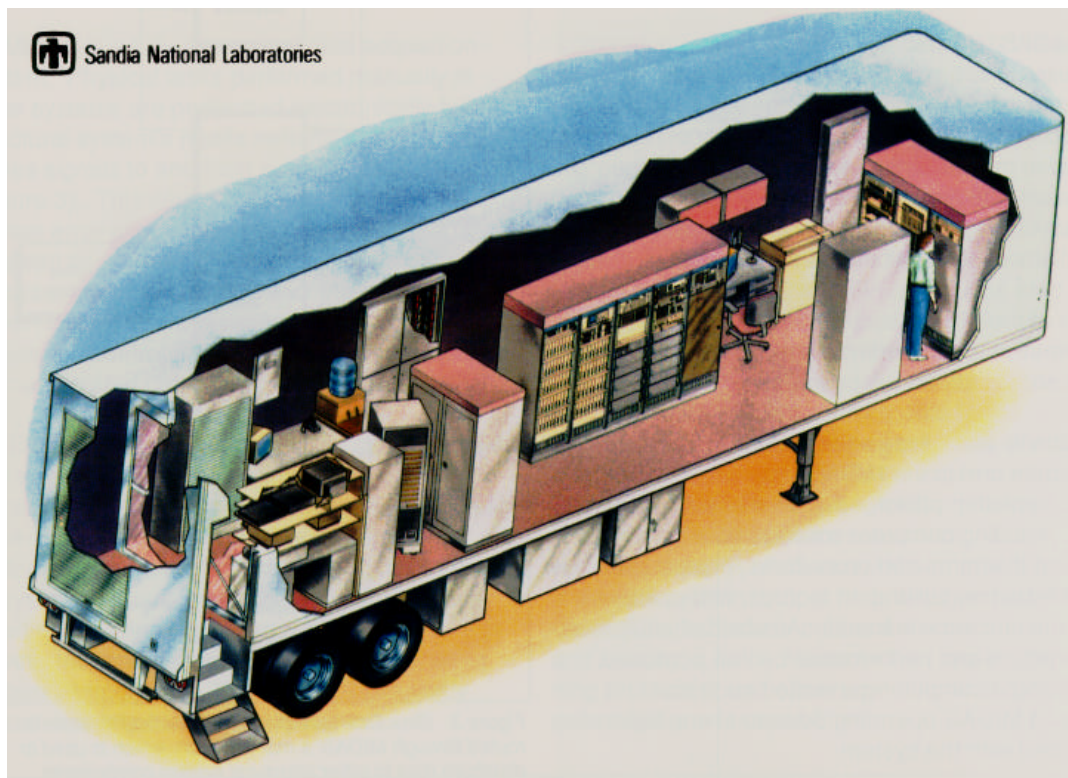
1.3.3.1

Fire Testing is Conducted at the 30x60 Foot Open Pool Fire Facility



1.3.3.1

Test data at all of these facilities is collected using the Mobile Instrumentation and Data Acquisition System (MIDAS)



1.3.3.1

Instrumentation

- Develop and evaluate measurement devices and techniques used to collect package response data from the testing of radioactive or hazardous material packages.
- Provide state-of-the-art instrumentation for testing and data recording to meet the rigorous QA requirements of the US NRC and IAEA.

FY99 and FY00 Activities

Complete investigation and begin integration of Lab View into the MIDAS trailer.

Certification Support

Voluntary Standards Supporting the “National Technical Transfer and Advancement Act of 1995” (PL 104-113)

ASTM C-26 Mixed Waste and Repository Waste/Spent Fuel

- **Pyrophoricity of Spent Fuel/Uranium**
- **Standard Guide for Interim Storage of Spent Fuel**
- **Standards for Mixed Waste**
- **The European Network on Quality Checking Facilities**
- **Multi-Purpose Packaging**

ANSI N14 Radioactive Materials

- **N14.5 for Radioactive Materials - Leakage Tests on Materials for Shipment - Draft Revision Review**
- **Membership Request**

FY99 and FY00 Activities: Certification support for DOE packagings will be provided as requested by DOE. Submit status reports and annually report.

1.3.3.1

Gas Generation

Address the safety concerns about fire, explosion, and high-pressure hazards in transport packagings of wastes containing radioactive and inorganic and organic materials within the DOE complex.

An example of such an occurrence is shown here.

FY99 and FY00 Activities:

Begin Thermal testing of generic classes of transportation packagings materials to determine their gas generation rates. Compare study results with existing codes. Document results of work.

Drum explosion at ANL-East



Conclusion

***The Advanced Transportation Technology Program
is 100% Applied and is Essential To Meet
The Needs of DOE Programs.***